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Katz et al.

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(54) **SYSTEM AND METHOD FOR ACTIVE SONAR SIGNAL DETECTION AND CLASSIFICATION**

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(58) **Field of Search** 367/87, 88, 100,
367/131; 702/14

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,054,862 A * 10/1977 Backman, Jr. 367/100

OTHER PUBLICATIONS

Caughey et al., "Blind Deconvolution of Echosounder Envelopes", Acoustics, Speech and Signal Processing, 1996 ICASSP-96, 1996 IEEE International Conf., vol. 6, May

1996, p. 3149-3152.*

Alpher, P., "A Consideration of the Discrete Volterra Series", IEEE Transactions on Automatic Control, Jul. 1965, pp. 322-327.*

Morgan, D., "On Discrete-Time Amplifiers", Circuits and Systems, IEEE Transactions on, vol. 22, Issue:2, Feb. 1975, pp. 135-146.*

* cited by examiner

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(57) **ABSTRACT**

A sonar system and method are provided to extract and identify information about a particular target illuminated by an active sonar system. The present invention utilizes a Volterra Series Expansion in conjunction with a least squares procedure to estimate channel and target responses, which may be linear or nonlinear. The system estimates the channel and target responses for different orders of the Volterra Series Expansion and then selects the order for which a minimum error is determined with respect to a measured acoustic return signal. The system requires as inputs only the excitation waveform and the measured acoustic return signal.

20 Claims, 2 Drawing Sheets

